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GENDER AND INTRAHOUSEHOLD ASPECTS OF FOOD POLICY

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Effects of Diet in Improving Iron Status of Women: What Role for Food-Based Interventions?

RESEARCH PROJECT MISSION

Intrahousehold resource allocation can predict the outcomes and consequences of policies targeted at households or individuals. With this knowledge and understanding, the research team aims to generate information that will assist in the development of policies, programs and projects that take intrahousehold allocation processes into account.

Policy Background

Poor diet quality and low bioavailability of dietary iron are important factors contributing to iron deficiency anemia (IDA). Nevertheless, can food-based interventions be successful in reducing IDA? Will such interventions be cost-effective as compared with alternative interventions such as supplementation? Unfortunately in attempting to answer these questions, little is known, under actual living conditions in rural areas, about the magnitude of the effects of various components of the diet in reducing IDA.

Hemoglobin concentration is a widely used measure for assessing iron deficiencies. Modeling the proximate determinants of hemoglobin concentration measured in the field through a finger prick can provide valuable information for deciding the allocation of resources between interventions such as (i) iron fortification of rice through plant breeding, (ii) government policies encouraging meat, fish, and poultry production, and (iii) provision of iron supplements.

Methodology

Compete data were available for 514 women in three survey rounds from three rural sites in Jessore, Manikganj, and Mymensingh. In each of the three survey rounds, food intakes were measured using the 24-hour recall method for the four meals consumed, i.e., breakfast, lunch, dinner, and snacks. The women's intakes of nutrients at each meal were estimated using food composition tables for six countries.

Diets of the poor in Bangladesh are dominated by rice. Thus, the phytate content of the meal is typically very high. Phytates chelate iron, thereby reducing iron absorption. An algorithm developed for calculating iron bioavailability in the presence of enhancers such as meat and vitamin C was recently extended in the nutrition literature to incorporate the inhibitory effects of phytates. This algorithm is used to calculate bioavailable iron in the diet, which is then used as an explanatory variable in modeling hemoglobin concentration.

Low Amounts of Bioavailable Iron in the Diet

Average iron intakes of women were estimated to be 6.93 mg/d, of which only 0.33 mg/d came from meat, fish, and poultry (MFP). Plant foods, then, provide most of the potentially bioavailable iron in the diet. Fourteen percent of the heme iron from MFP was assumed to be bioavailable (0.05 mg/d of absorbed heme iron). Depending on assumptions as to body iron stores and effects of phytates, bioavailable nonheme iron ranged from 0.80 mg/d (12 percent bioavailability) to 0.05 mg/d (1 percent bioavailability).

Adult women require 2 mg/d of absorbed iron. Thus, knowledge of the actual iron absorption rates in undernourished populations is of critical importance for assessing the efficacy of alternative food policies. For example, if the body is capable of absorbing greater quantities of nonheme iron because of low body stores (e.g., a 12 percent absorption rate), then iron fortification of rice through plant breeding could be effective in alleviating iron deficiencies. By contrast, higher intake of MFP or iron supplementation would be necessary for improving the iron status of adult women if the absorption rates are as low as 1 percent.

The models estimated for Bangladeshi women's hemoglobin concentration showed statistically significant effects of the bioavailable iron when the enhancers were used in the calculations of bioavailable iron. Coefficients of the bioavailable

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iron increased by 50 percent and were more precisely estimated when effects of phytate intake was also taken into account. The coefficient for women taking iron supplements was also statistically significant. These regression coefficients may be used to evaluate the relative cost-effectiveness of alternative interventions.

Relative Effects of Diet and Iron Supplements on Blood Hemoglobin

An international effort to breed for micronutrient-dense staple food crops as a means to reduce micronutrient malnutrition has been ongoing since 1995. The most progress has been made for rice. Research under the CGIAR micronutrients project suggests that the amount of iron in rice can be doubled, using conventional breeding techniques and maintaining high yields so that these varieties will remain profitable and so attractive to farmers to adopt.

The cost of plant breeding research is typically a one-time fixed investment, costing a few million dollars for one country for a specific crop and nutrient. For example, an ***upper bound*** for fixed developmental costs for iron-fortified rice for Bangladesh may be set at $6 million. The average intake of rice by women in our sample was approximately 500 g/d. An improved rice variety might increase nonheme iron intake from 6.6 mg/d to approximately 10.6 mg/d. This would constitute an increase in bioavailable iron of between 0.04 mg/d (1 percent bioavailability of nonheme iron; a 40 percent increase in total bioavailable iron) to 0.48 mg (12 percent bioavailability of nonheme iron; a 56 percent increase in total bioavailable iron). Assuming that the improved rice variety would reach one-half the Bangladeshi population (65 million out of 130 million) for 10 years, the cost of iron fortification of rice would amount to 1 cent per year for each person.

Regression coefficients indicate that the effect of iron supplementation in improving population hemoglobin is 3.5 times as strong as doubling the amount of iron in rice as just calculated above. However, the cost per person reached using supplementation is more than 100 times as high. The cost of supplementation is $1.70 per person per pregnancy.

It can be misleading to compare the costs of iron fortification through plant breeding and supplementation with the costs of increasing MFP consumption in that MFP provides not only iron, but a range of nutrients and other compounds that are necessary for a balanced diet. Nevertheless, looking strictly at iron and using the algorithm for calculating bioavailable iron, MFP consumption would have to triple to match the effect in improving blood hemoglobin of development of high-iron rice through plant breeding.

The costs of realizing such an increase in MFP would be quite substantial. Households in our sample spend 70 percent of their total expenditures on food and 25 percent of the food budget is spent on MFP. This implies that 17.5 percent of total household expenditures are allocated to MFP. Tripling MFP consumption, then, would cost an extra 35 percent over present expenditures. Per capita total expenditures per year for our population are approximately $200/year. The increased MFP consumption would cost about $70 per year per person. These costs can be reduced by introducing new technologies to the livestock and fish sectors, improving productivity, increasing the supply, and lowering prices for MFP. However, MFP prices will never go so low as to approach the cost-effectiveness of fortification or supplementation.

Policy Conclusions

Plant breeding holds great potential for providing a low-cost intervention that could help to improve iron status broadly for populations with a high prevalence of iron deficiency. The degree of success will depend on the levels of minerals, vitamins, promoting compounds, and anti-nutrients that plant scientists are able to breed into high-yielding, profitable varieties of staple food crops. This breeding process, however, needs to be informed by human nutritionists—what are the optimum breeding objectives in terms of having a maximum nutrition impact? The precise answers that are required of human nutritionists will require further research, such as the feeding trials using human subjects to determine the bioavailability of iron and zinc in nutritionally-improved varieties.

Although cost-effective, plant breeding is only one of several interventions that are all required in tandem to reduce micronutrient malnutrition. Of those examined in this analysis, supplements are needed particularly in the short run when requirements are high (e.g., pregnancy) and/or iron deficiency is acute. Promoting more rapid growth in production of MFP is likewise crucial. Prices of MFP, adjusted for inflation, have risen substantially over the past 25 years in Bangladesh at the same time as the inflation-adjusted price of rice has fallen by 40 percent. This, in addition to low incomes, explains why MFP consumption is so low and rice consumption remains high. MFP provide a range of highly bioavailable nutrients and other compounds that are essential are good nutrition. Production must keep pace with population growth and increases in demand due to higher incomes and urbanization, if prices of MFP are not to rise and cause a further lowering of consumption among poor households. ■

ABOUT IFPRI

IFPRI's mission is to identify and analyze strategies for meeting food needs of the developing world, with particular emphasis on low-income countries and the poor.

IFPRI is a member of the Consultative Group on International Agricultural Research (CGIAR).

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